

*The Total Eclipse of the Sun, July 29, 1878.*

By F. C. Penrose, Esq.

In company with three members of this Society and some others, I embarked on board one of the steamers of the White Star Line (the *Germanic*) and afterwards proceeded, with the larger portion of the party, to Denver, in Colorado, for the purpose of observing this eclipse. I took up a position on the outskirts of Denver, in N. latitude  $39^{\circ} 46' 29''$  and W. longitude  $105^{\circ} 1' 43''$ , as ascertained by triangulation from a standard point in Denver, the altitude above the sea level being about 5,500 feet.

The threatening weather of the eight days previous to the eclipse had pointed out the propriety of the observing parties being separated, and this we had done to some extent. Mr. Ran- yard was with Professor Young about 5 miles distant and Mr. Loder and his party were at an intermediate point in Denver itself. I was assisted by Mr. Baldwin, a young gentleman of Denver who had been introduced to me through Professor Young. I used a  $2\frac{1}{4}$ -inch achromatic by Troughton & Simms, with power 30 and field of view  $74'$ .

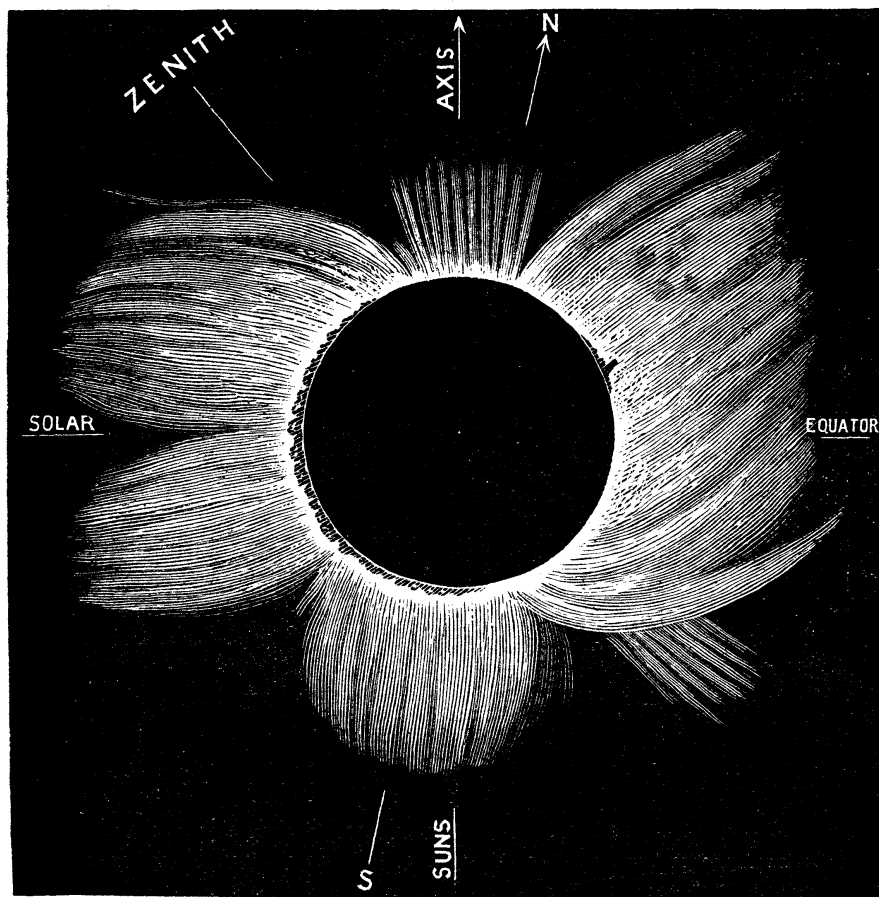
My principal object was to draw the corona, but I also en- deavoured, so far as it did not interfere with my main purpose, to note the time of the four principal phases. In this I partly suc- ceeded; but, owing to the hurry which resulted from having to rearrange some defences against the wind, which was blowing rather fresh, I did not get a good observation of first contact. The wind fell as the eclipse advanced, and nothing could be more favourable than the atmospheric conditions. My observation of second contact was better, but I consider it uncertain to about two seconds. As for the two last, I have no reason for supposing them to be more than a second in error.

	Locat. M.T.		
	h	m	s
First contact	2	19	29.4
Second contact	3	28	51.5
Third contact	3	31	35.6
Fourth contact	4	34	49.6

As totality approached I was much struck with the shortness and apparently equal width and blunted ends of the diminishing remnant of the photosphere. I saw no sign of Baily's beads, and the white light was extinguished at once, like a gas lamp turned off suddenly. I withdrew at once the grey screen I had been using and saw the rosy tints of the chromosphere and immediately afterwards the silvery corona.

My companion called the time during the first minute, during which I passed the scale which I had in the eye-piece completely round the Moon, and ascertained that I could trace the extent of the corona for 28 minutes of arc in the direction of the ecliptic

eastwards, and nearly as far, but not quite, in the opposite direction, but nowhere else so far. I then made some pencil records of the streamers of the corona and occupied myself during the short remainder of the time in studying its (true) northern half, and in the drawing whatever is shown of this half



should have more weight attached to it than to the other. I took but little notice of the prominences, but could not help observing a bright hooked one which appeared to me to shoot out towards the east not long before totality ended. I believe some other observers noticed two hooked prominences in the same neighbourhood.

Almost directly after totality had ceased I left the telescope to the care of my companion and went aside and made a coloured drawing of what I had just witnessed, and it is from this rough sketch and the lines drawn during totality that the drawing has been composed. I have, however, added to it, in a paler tone of colour, some features which have been supplied to me by Professor Cleveland Abbé and which has been confirmed by other observers, namely Mr. Lockyer, who observed

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during part of the time, and Dr. Edmunds, of Denver, who observed throughout with the naked eye and saw streamers at a much greater distance than could be seen in the telescope, of the similitude of a wind vane. I looked up for about a second without the telescope and saw nothing but the intensely black Moon surrounded, or nearly so, with a rosy garland apparently of much greater width than the sierra had appeared in the telescope, but I did not look long enough to get my eye into focus. Professor Abbé has described these streamers as having, in his opinion, a meteoric origin, and I have made a diagram which shows that none of the lines which either these observers or I have recorded is inconsistent with this view.

The pointed ends of the "wind vane," of which I have given the observed lines in red, seem to favour the explanation of an elliptic orbit of considerable major axis and great excentricity, such as would fall in with the blue lines. The wedge-like point proceeding from the north pole of the Sun would agree with a similar figure, whilst some of the others can be explained by orbits of meteors of less extent. It is obviously not requisite that the Sun's centre should be the focus of the apparent orbit, as it would be modified from the real figure by perspective. The red lines on the diagram, with the exception of those belonging to the "wind vane," are all of them enlargements of the lines which I mapped down during totality, without having any idea or theory of the possible meteoric origin of the corona; which, however, both the spectroscopic and eye observations seem to combine in rendering probable.\*

I am far from arguing that this theory answers for the whole of the corona, and I much doubt whether it will explain the almost equal and radial lines which proceeded from the neighbourhood of the Sun's north pole, and which appeared to me the most beautiful part of the whole. There was also something analogous near the Sun's south pole, but not so clearly radial. I did not, however, examine this part so closely. The rays proceeding from the north pole seemed of a rather warmer colour than the rest of the corona, and I thought, but am not

\* For want of space the woodcut does not give the more distant streamers &c. referred to in the text as seen by the naked eye, but is confined to my own observations: neither does it attempt to represent the blackness of the Moon. In the drawing I found it necessary to embody the particulars referred to for the purpose of giving a truer rendering of the background upon which I saw the corona projected. I had myself noticed and recorded during totality that it seemed to shade off imperceptibly in the direction of the solar equator, both east and west, whilst its termination was more clearly defined in other directions: a uniform ground therefore would not have been correct.—F. C. P.

The diagram referred to in the text, as well as the drawing showing the additional streamers observed by Prof. Cleveland Abbé, Mr. Lockyer, and Dr. Edmunds, can be referred to at the Society's apartments.—Ed.

sure, that there was some slight movement or palpitatio at their extremities.

In the eastern part of the corona there seemed to be, but only faintly, some signs of dapplings of a darker grey than the rest. Were these perhaps meteor streams seen from the Earth in section and so rather intercepting the light of the more luminous parts? It will be remembered that, judging from the analogy of the November meteors, these bodies may not be uniformly scattered in their orbits, and it may easily happen that the part where the meteoric bodies are thickest may be too far from the Sun to receive much illumination. Just after the reappearance of the Sun several serpentine fringes were seen moving southwards along the ground, at no great distance apart and at an estimated pace of about 5 miles an hour, and about 8 inches broad. They were brown themselves, but the light between them was of a golden hue.

I must not conclude without a word of recognition of the kindness we received from the American astronomers, of the liberality of the railroad authorities of the United States, and the co-operation of the company and officers of the White Star Line of steamers.

November 1878.

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*On the progress of the Reductions connected with the Ascension Expedition.* By David Gill, Esq.

I beg to submit to the Society the following report on the observations of *Mars* made at Ascension.

1. The observations for time, made with the 30-inch transit instrument by Cooke, belonging to the Society, have been reduced. Time was determined, as a rule, each second or third day, and by comparisons at the time the error of each of the five chronometers was ascertained.

The error of the chronometer used when observing *Mars* was then deduced for intermediate intervals from its comparison with the stationary chronometers, and thus four independent determinations of its error before and after each series of observations were obtained. On no single occasion, however, do the results so obtained differ half a second from the interpolated rate of the observing chronometer.

2. The observations of the Sun, made at St. Helena and Ascension with the reflecting circle, to determine local time, are also reduced; the following are the results for difference of longitude:—

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